occasional in occurrence and locality to justify this. We do not know but that all aquatic cases would have metamorphosed under suitable conditions, and the terrestrial form is indicated as being definitive by the anatomy of the circulatory and respiratory apparatus. Also we do not share Powers's objection to the name axolotl and siredon as a designation for the aquatic form; both have the sanction of general usage and do not apply to other animals, so that they are entirely clear.

H. L. O.

EXPERIMENTAL ZOOLOGY

Some Experiments on the Development and Regeneration of the Eye and the Nasal Organ in Frog Embryos.[1]—Dr. E. T. Bell has conducted a series of experiments on embryos of *Rana esculenta* and *R. fusca,* in which he found certain new facts in the development of the eye and nasal organ. Wolff had shown in 1894 that the crystalline lens of the salamander may be regenerated from the upper margin of the iris. Fischel also found later that the lens in the newt's eye would regenerate from the iris, and by wounding the iris in several places after removal of the original lens that one or more lenses were formed. Spemann, Lewis and others show in amphibian embryos that there is no localization of lens-forming material in any given area of the ectoderm, and that the formation of a crystalline lens depends directly upon the stimulation of the ectoderm, or outer embryonic wall, through contact with the optic-cup. Lewis in a series of interesting experiments in which he tranferred the optic-cup from its original connection with the brain to a more caudal position showed that when it came in contact with the ectoderm in this new region the optic-cup stimulated lens formation. In another instance the skin from the ventral surface of *Rana sylvatica* was placed over the optic-cup of *R. palustris* and gave origin to a lens.

Bell has discovered several other possible sources of origin for the crystalline lens. He cut off the optic-vesicle of the embryo and turned it completely around so that the former outer side now turned toward the brain; under these conditions the pigment layer of the retina itself was induced to form a lens-like structure. When the brain was opened in the mid-

[1] *Archiv für Entwicklungsmechanik der Organismen,* XXIII, pp. 457–478, pl. 14 to 20.

dorsal line and the right optic-vesicle of another embryo of about the same size was put completely inside, the brain tissue, provided it had not become too far differentiated, gave rise to a lens. In another case a lens was formed from the surface ectoderm although the cavity of the optic-cup was turned away from the surface. An optic-vesicle which came in contact with the early nasal organ caused this structure to form a lens. Finally, the lens of one eye budded off another lens to supply an optic-vesicle which was placed adjacent to it. Bell's experiments seem to show that all ectoderm cells before becoming specialized to any considerable extent have the power to differentiate into lens cells, though all of his experiments are not equally convincing.

A lens failed to form from the endoderm when the gut was opened and the optic-vesicle turned down into its cavity.

King with the frog and Dragendorf with the chick have shown that the optic-vesicle may regenerate when parts of its early structure are removed. If, however, the eye-forming region be completely destroyed these authors claim that no regeneration takes place. Bell, on the other hand, finds that when one lateral half of the brain is removed it will regenerate and at times an optic-vesicle forms on the regenerated side. He also removed, by means of fine scissors, the entire Anlage of the eye and found a new optic-vesicle to regenerate. The previous experimenters used heated needles for destroying the eye and Bell believes that this method injures the adjacent tissue from which regeneration might take place.

The formation of the pigment layer of the retina, Bell claims, is dependent upon the retina proper. There is also some evidence to show that the retina may cause undifferentiated epithelium to become pigmented when brought into relation with it at the proper time.

Bell finds that the optic, as well as the olfactory nerve, may be induced to follow a path that can in no sense be preformed.

The olfactory lobes of the brain when brought into contact with ectoderm out of the nasal region are unable to stimulate the formation of nasal structures. The nasal anlage is readily regenerated if removed at certain stages and its early development is independent of the parts of the brain and buccal epithelium with which it normally connects. The nasal structure is developed from a predetermined area of ectoderm and when this portion of ectoderm is transplanted to a position

above and behind the eye the nasal pit still forms and the olfactory fibers which develop in it grow into the lateral wall of the diencephalon above the eye, which is of course an unusual region for these nerve fibers to enter.

C. R. STOCKARD.

The Influence of Regeneration on Moulting in Crustacea.—A recent paper by Dr. Margarete Zuelzer[1] furnishes additional data regarding the influences of regeneration, or the replacement of lost parts, on the moulting process in crustacea. It is generally known that the members of this group have the power to grow new appendages, legs, antennæ or swimmerets, after the former ones have been lost through accident or injury. In order to produce the new limb as well as to grow, or increase in body size, the crustacean must moult its hard chitinous shell. The processes of growth are closely associated with moulting and the more frequently the animal moults the faster will it increase in size. When one of these animals has lost a limb it is usually replaced by a small new one during the next moult following the injury.

Since the moulting period is so closely connected with the normal rate of growth several investigators have endeavored to ascertain what effect regeneration might have on the interval between these periods. Zeleny found that crayfish while regenerating their limbs moult faster, or more frequently, than normal individuals, and, further, he holds that an animal regenerating several limbs moults more frequently and regenerates the limbs faster than one replacing a single appendage. He concludes that during regeneration the moulting process is hastened. Emmel, on the other hand, has reached an opposite conclusion from the study of a large series of young lobsters. He finds normal individuals moulting more frequently than others which are regenerating new limbs. Lobsters that have lost several appendages moult slower than those that have lost fewer. Emmel, therefore, believes that regeneration retards the moulting process. He showed very clearly that an important factor, which Zeleny had failed to take into account, was the time at which regeneration was introduced into the moulting cycle. If the limbs were removed the day after moulting the moulting period remained almost normal, but when the limbs were removed four days after the moult the resulting regeneration

[1] Uber den Einfluss der Regeneration auf die Wachstumsgeschwindigkeit von *Asellus aquaticus* L. *Arch für Entwick.-Mech.*, XXV, Dec., 1907.